Water investment domains for sustainable agricultural development in the Blue Nile basin

Introduction

The Blue Nile basin is one of the major agricultural areas of Ethiopia. Crop cultivation is predominantly rainfed. Water availability often constitutes a limiting factor for reaching full agricultural potential. It is highly variable across both space and time, though.

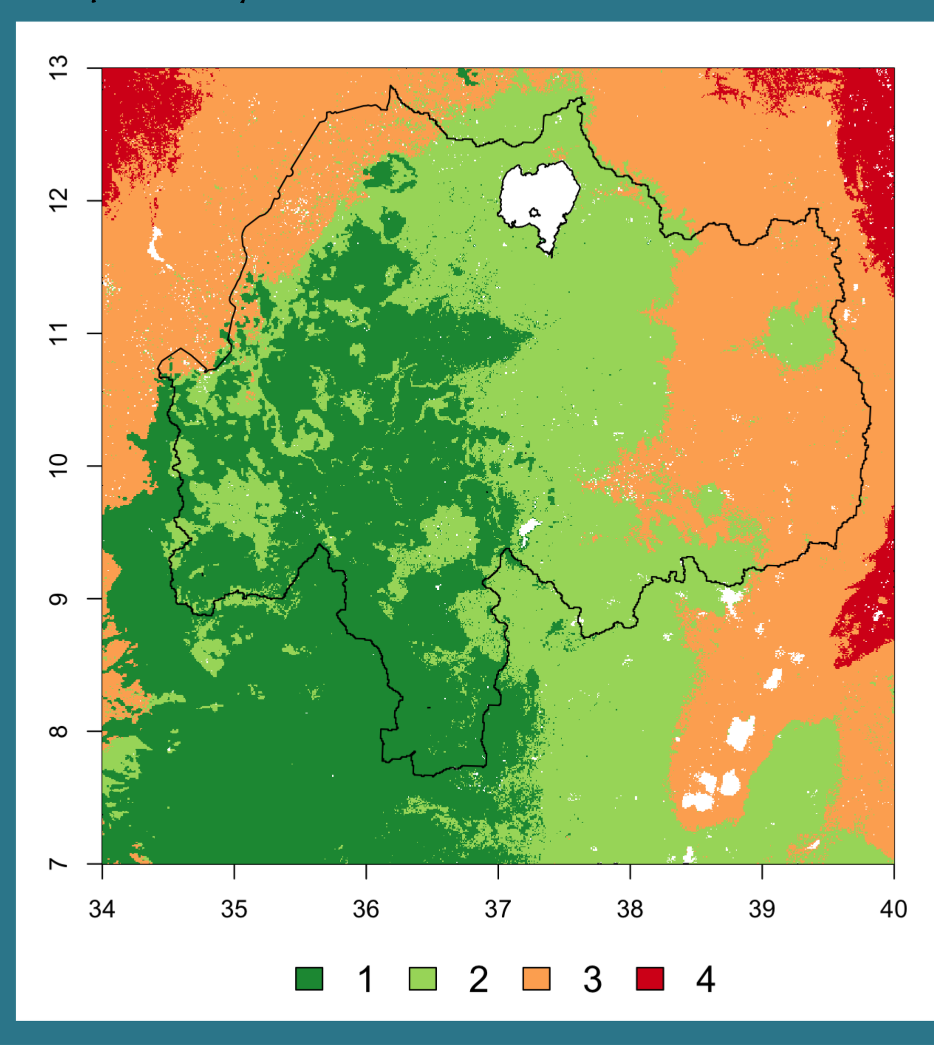
A great deal of variation also exists in terms of market access for agricultural inputs and produce. One's distance to market centers influences the accessibility of farm inputs. It determines the potential for agricultural production and the marketing of crops and livestock products, in particular for perishable produce.

The Blue Nile basin demonstrates a high degree of heterogeneity in terms of bio-physical and socio-economic aspects. The way these factors interact influences both the applicability and impact of interventions.

To capture the complexity and heterogeneity regarding both crop water limitations and agricultural market access, this study combines information on rainwater management potential and market proximity to map so-called water investment domains .

Rainwater management potential

Rainwater management potential is derived from normalized difference vegetation index (NDVI), potential evapotranspiration (PET) and precipitation (P).
For each growing period the overall P/PET ratio was determined and assigned as the average water availability to demand ratio for that period. NDVI is used to compare sites with comparable moisture regimes in terms of their "greenness".
Sites that appear less green than expected for their moisture regime use the available water sub-optimally.



Class 1 – NML: Not moisture limited crop growth, no need for RWM

a) all areas with P/PET>1.4, here optimal achievable NDVI values indicate that plant growth is not moisture limited;
b) some of the areas with P/PET 0.7-1.4, i.e. less soil moisture, but still showing optimal NDVI.

In Class 1 there is no need for RWM

Class 2 – SMA: Sufficient moisture, optimal crop growth possible, with RWM interventions

Areas with a P/PET range of 0.7-1.4 showing sub-optimal NDVI values. Available soil moisture is not utilized in the best possible way. Thus, with smart RWM practices available moisture can be sufficient for optimal plant growth.

Class 3 – LMA: Limited moisture, optimal crop growth not possible, RWM to optimize sub-optimal water availability

Areas with a P/PET ratio less than 0.7. Here soil water deficits clearly limit plant growth. Rainfed agriculture is still possible, but optimal yields are not achievable. By meticulously applying RWM practices crop growth can be considerably improved, i.e. reach optimal growth within existent local soil moisture constraints.

Water Investment Domains (WIDs)

= geographical units in which similar water-related agricultural development problems or opportunities are likely to occur.

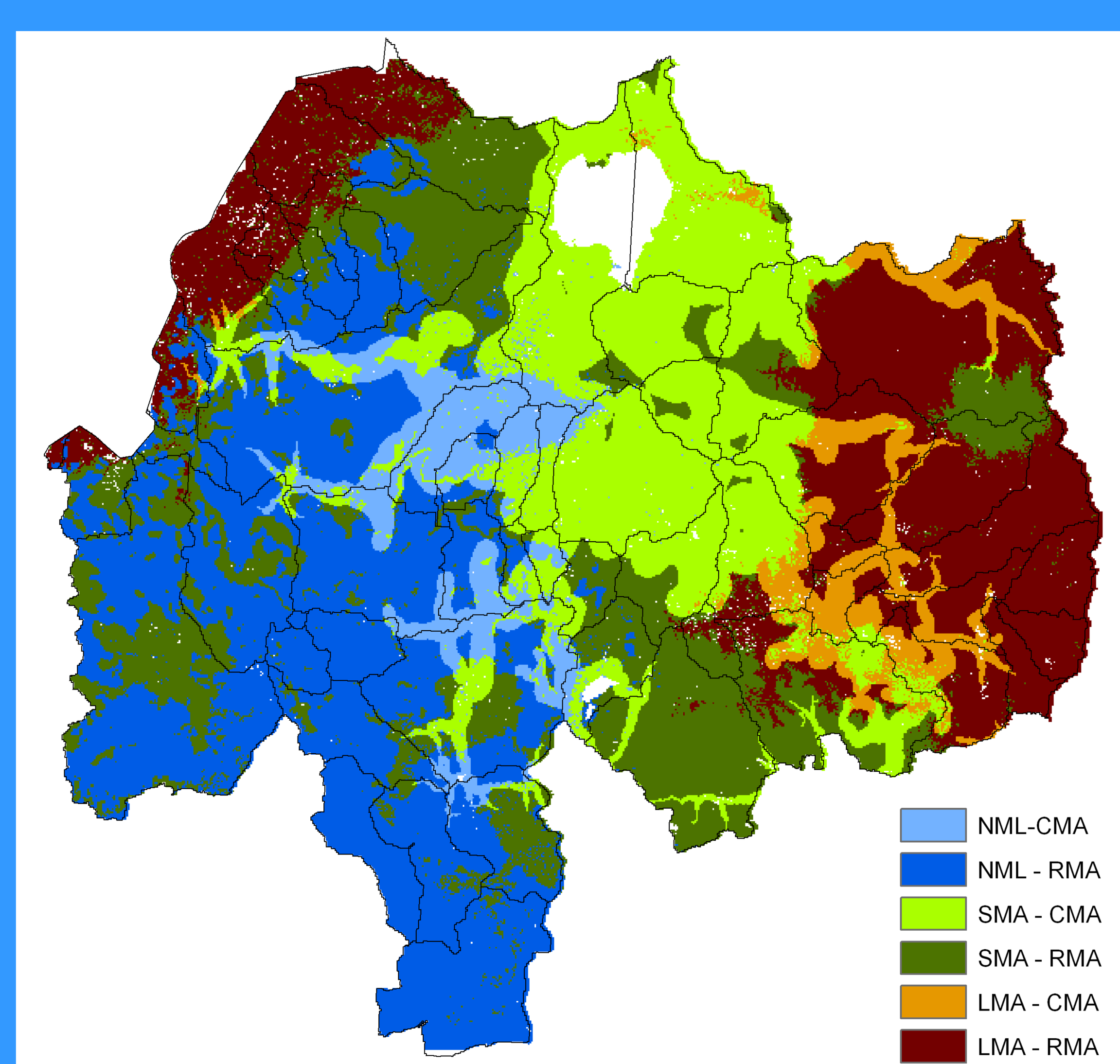
Soil moisture and crop growth	RWM need	Market access	Water Investment Domain (WID)
No **M**oisture **L**imitations, full crop growth	No need	**C**lose	NML-CMA
		Remote	NML-RMA
Sufficient **M**oisture **A**vailability, optimal crop growth possible	RWM to reach optimal crop growth	**C**lose	SMA-CMA
		Remote	SMA-RMA
Limited **M**oisture **A**vailability, optimal crop growth not possible	RWM to optimize use of limited moisture	**C**lose	LMA-CMA
		Remote	LMA-RMA

SMA-CMA and NML-CMA are the two most agriculturally intensive areas, with approximately two thirds of each of their areas cultivated.

Comparing accessible with remote areas, higher shares of cropland mosaic are found in the more accessible WIDs.

Highest numbers and highest densities of people and livestock are found in the SMA-CMA domain.

In general, a higher population density (human and animal) can be found in the accessible areas as compared to the remote areas.



The highest shares of "mixed livestock & crop" systems are close to markets.

"Only livestock" systems are found in higher shares in remote areas . In total > 90% of the only livestock systems are in RMA domains.

Water Investment Domain (WID)	Population		Livestock		Area (km^2)				Agricultural system	
	People	Share total	TLU*	Share total	Total area	Share total	Cropland mosaic	Share WID	Only livestock	Mix livestock & crops
NML-CMA	1 048 000	6%	428 334	6%	11 503	6%	7 266	63%	12%	85%
NML-RMA	2 743 730	15%	1 076 666	15%	51 233	26%	20 132	39%	31%	66%
SMA-CMA	6 464 680	34%	2 061 871	29%	41 108	21%	27 034	66%	4%	95%
SMA-RMA	3 394 520	18%	1 522 003	21%	42 873	22%	19 570	46%	21%	79%
LMA-CMA	1 331 040	7%	476 488	7%	9 204	5%	5 061	55%	1%	98%
LMA-RMA	3 924 140	21%	1 575 552	22%	38 964	20%	12 320	32%	24%	76%
	18 906 110	**100%**	**7 140 915**	**100%**	**194 885**	**100%**	**91 383**	**47%**	**19%**	**79%**
* TLU = tropical livestock units										

Recommendations

The Blue Nile basin has great agricultural potential.

Almost half of the high potential area is exhibiting optimal plant growth. This provides good opportunities for high-value perishable crop and livestock products.

In the other part of the high potential area there is a need for more well-targeted RWM interventions. Most of this area is cultivated under a mixed crop-livestock system and has high potential to use the livestock component to increase the resilience of the overall system.

In a considerable portion of the areas with no or limited soil moisture limitations there is a need to invest in infrastructure.

Currently about one third of the remote NML-RMA domain is exploited in a livestock-only system. Despite the lack of investments in roads and market infrastructure, good potential for non-perishable crops exists. It would thereby be very important to look at the larger-scale impacts on the livestock production.

Significant soil moisture limitations are only experienced across 25% of the Blue Nile basin's area. In these areas it is very important to put appropriate RWM in place and by doing so to increase the resilience of the systems. Technologies such as drought-resistance crops, feed purchasing systems, water harvesting, including storage structures and soil water management and diversification can help to deal with variable circumstances.

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